

**Published Mark Scheme for  
GCE AS Technology and Design**

**Summer 2010**

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**NORTHERN IRELAND GENERAL CERTIFICATE OF SECONDARY EDUCATION (GCSE)  
AND NORTHERN IRELAND GENERAL CERTIFICATE OF EDUCATION (GCE)**

**MARK SCHEMES (2010)**

**Foreword**

***Introduction***

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

***The Purpose of Mark Schemes***

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.



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New  
Specification



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2010**

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## **Technology and Design**

**Assessment Unit AS 1**

*assessing*

**Product Design and Systems and Control**

**[AV111]**

**WEDNESDAY 16 JUNE, AFTERNOON**

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# **MARK SCHEME**

In all cases, correct alternative responses will be given full credit.

### Section A

- 1 (i) Briefly explain the difference between hardwoods and softwoods  
Hardwoods – from deciduous trees grown in the warmer temperate regions  
Softwoods – from conifers grown in the cooler regions. [1]
- (ii) **Two** main characteristics why Oak is suitable for furniture from the following:  
• Hard and strong  
• Aesthetically pleasing  
• Produces long straight-grained timber suitable for furniture [2]
- (iii) **Two** main characteristics why Pine is suitable for floorboards from the following:  
• Hardwearing and durable  
• Aesthetically pleasing  
• Quite stable. [2]
- 2 (i) Briefly explain what is meant by each of these terms  
**Use of Tolerance** reference to the + or – measurement that is acceptable [1]  
**Batch production** – The production of a specific quantity of a product. [1]  
**Statistical Testing Methods** Refers to the use of statistics to generate the selection of components or finished products for testing. [1]
- (ii) **Two** main reason why this company would use common form and sizes of materials from the following:  
• More widely available than customised sizes  
• More cost effective to use them [2]
- 3 Components such as metal washers can be produced by the process of blanking.
- (i) The most common form of metal used in the blanking process.  
Sheet metal. [1]
- (ii) Suitable sketch of the blanking process to include the hydraulic press with punch, sheet metal and die [2]  
Description. [2]



- 4 (i) **Two** main characteristics why ABS is used from the following:
- Bright shiny colours can be achieved
  - Resistance to scratching
  - Non toxic
  - Suitability for injection moulding
  - Tough.
- [2]

- (ii) **Two** main characteristics why polystyrene is the material used following:
- Good heat insulation properties
  - Lightweight, low cost
  - Non contaminating/ safe for liquids and foods.
- [2]

- 5 (i) Briefly outline **two** main characteristics associated with Solid modelling, **two** main characteristics associated with virtual imaging and **two** main characteristics associated with rapid prototyping.

**Two** main characteristics associated with Solid modelling from the following:

- Computer based pictorial views provided
  - Contains information about the volume and mass of the object
  - Suitable for section views.
- [2]

**Two** main characteristics associated with virtual imaging from the following:

- Three dimensional views of products on screen
  - Images can be manipulated on-screen to give sense of realism
  - Quick, interactive with client.
- [2]

**Two** main characteristics associated with rapid prototyping from the following:

- Like a 3D printer instead of ink it uses a solid material and 'grows' a three dimensional product.
  - Produces detailed products at relatively low cost
  - Relatively quick process compared to other 3 dimensional processes.
- [2]

**mark for clear and coherent explanation using good English grammar.**

[1]

- 6 Manufacturing process  
Eg.  
Lathe work – clothing getting caught in revolving parts – use of guards or sensors to prevent motor starting
- [2]

- Hand process  
Chiselling or sawing wood – Injury resulting from slippage – Good practice of keeping hands behind the blade.
- [2]

- 7 (i) **Two** specific examples of anthropometric data that the designer would need from the following:
- Length of feet for a specific age and gender group
  - Width of feet for a specific age and gender group.
- [2]
- (ii) Texture – is both visual and tactile and can influence the target audience when selecting suitable footwear  
Symmetry can create balance in a design giving it a sense of stability and can influence the target audience when selecting suitable footwear.
- [2]
- mark for clear and coherent explanation using good English grammar.**
- [1]
- 8 (i) The 3R's – reduce, reuse and recycle plus explanation
- [3]
- (ii) eg Recycling of plastic bottles, cans or paper. While this involves energy costs for collection, sorting and processing the benefits of saving materials and reproducing it into another product helps the environment.
- [2]

Section B

9 (a) (i) NAND Gate Exclusive OR [2]

(ii)

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

[2]

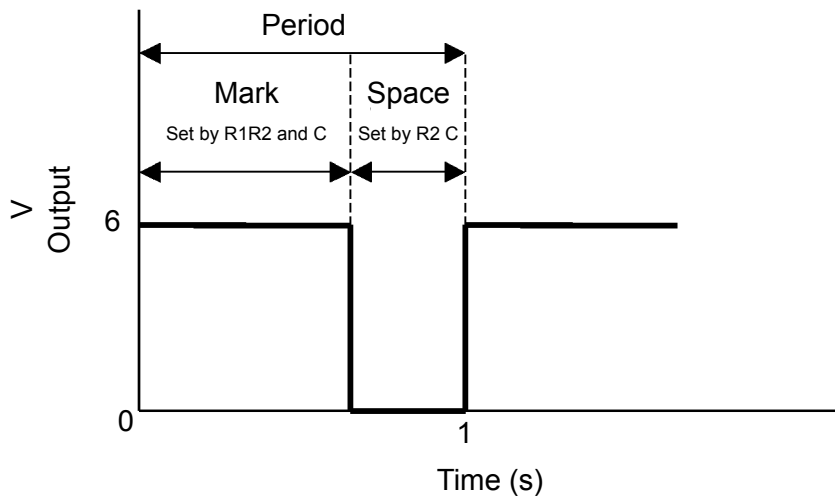
(b) (i) Or logic – The 6volt supply has 2 alternative paths through either switch A or switch B. [2]

+ QWC [1]

(ii) Astable – no stable state – in this case the output will switch between two voltages 0 volts and 6 volts [2]

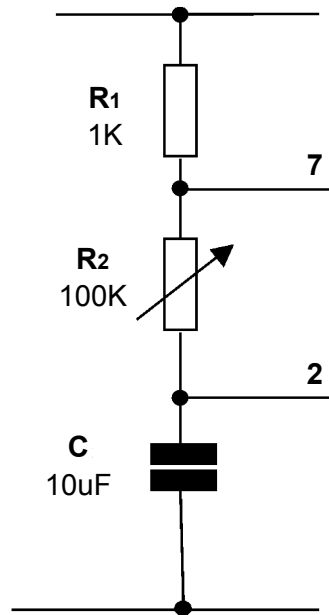
(iii)  $f = 1 \text{ Hz}$  [3]

(iv)



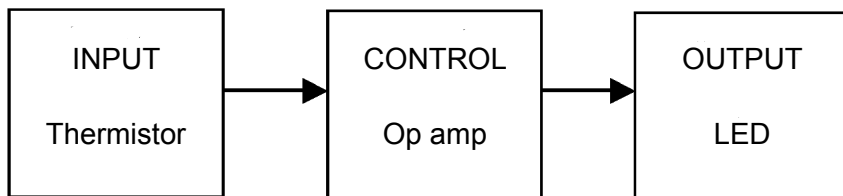
[4]

(iv) Sample answer.



[2]

10 (a) (i)



[3]

(ii) On off – since the comparator has effectively only two output states. [2]

(iii) Component R<sub>v</sub> – variable resistor to adjust the temperature at which the LEDs switch. [2]

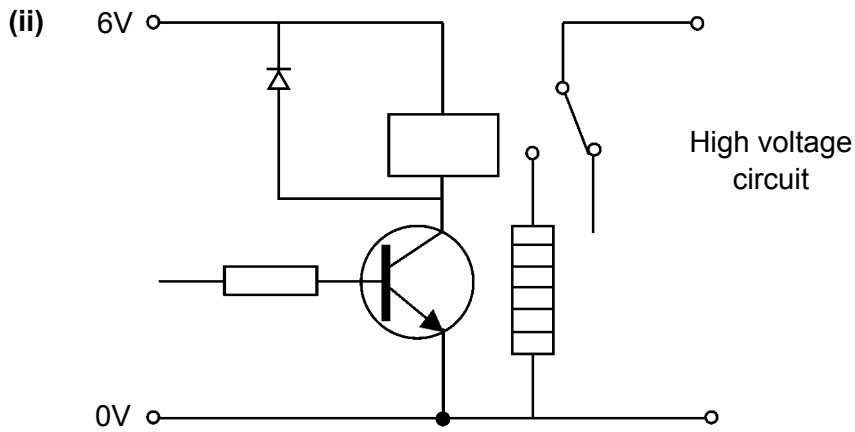
(iv) Hot conditions – resistance of thermistor decreases therefore voltage at non inverting input will decrease. Output will be –ve therefore LED 2 will switch on.  
Cold conditions – resistance of thermistor increases therefore voltage at non inverting input will increase. Output will be +ve therefore – LED 1 will switch on. [4]

+ QWC [1]

(v) R<sub>s</sub> = 480 ohms [2]

(b) (i) It refers to the maximum current that can safely flow from collector to emitter.

[2]



[4]

(iii)  $I_c = 6V/10 \text{ ohms} = 0.6 \text{ Amps}$   
 Required gain =  $600\text{mA} / 8\text{mA} = 75$   
 Transistor type 2

[2]

Section C

11 Fig 11 shows a mechanical system which includes a motor, chain and sprocket, pulley and gears.

(a) (i) State a mechanical component which could join Shaft **P** with shaft **Q** providing a substantial transmission speed reduction.  
**Ans** = Worm and wheel. [1]

(ii) State the direction of rotation at **Shaft R** if **A** rotates in an anticlockwise direction.  
**Ans** = Anticlockwise. [1]

(iii) Calculate the overall velocity ratio between **A** and **G**.  
**Ans** =  $A - B = 45/90 = 0.5$   
 $C - E = 60/60 = 1$  [1]  
 $F - G = 80/40 = 2$   
 $Tot = 0.5 \times 1 \times 2 = 1$  [1]  
 [1]

(iv) Calculate the output speed at **G** if **B** rotates at 120rev/min.  
**Ans** =  $VR = 2$  [1]  
 $120/2 = 60\text{rev/min}$  [1]

(v) Calculate the input speed of the motor if the velocity ratio between shafts **P** and **Q** is 20 and **F** rotates at 120 rev/min.  
**Ans** =  $VR F - B = 1$   
 $C - A = 0.5$  [1]  
 $P - Q = 20$  [1]  
 $TOT VR = 10$  [1]  
 $120 \times 10 = 1200\text{rev/min}$  [1]

(b) Shaft **R** is attached to pulley **G** using a grub screw. Using an annotated sketch outline the main features of this fixing method.  
**Ans** = Grub screw [1]  
 Housing of grub screw  
 Position of grub screw [1]  
 Or other suitable answer.

(c) The belt between pulleys **F** and **G** increasingly suffers from slippage. Self adjusting jockey wheel.  
**Ans** = Position of wheel  
 Spring loading/self adjusting  
 Description of components [3]

QWC [1]

Mark for clear and coherent explanation using good English grammar.  
 Or other suitable answer.

(d) Using an annotated sketch name and draw a system which would convert the rotary motion of shaft **R** into reciprocating motion of **Component 1**.

- Ans** = Crank and slider [1]  
 Sketch of crank [1]  
 Sketch of slider. [1]

12 Fig 12 shows part of an incomplete pneumatic system which includes two identical double acting cylinders.

(a) (i) Name the activation method at **A**.

**Ans** = Signal air. [1]

(ii) Name the activation method at **B**.

**Ans** = Plunger. [1]

(iii) Control the speed of the outstroke. Cushioning effect slowing the escaping air down. [2]

(b) (i) On the pro forma provided (answer number 12 (b)) complete the circuit enabling an outstroke of cylinder **X** to be followed by an outstroke from cylinder **Y** which in turn enables cylinder **X** to instroke.

**Ans** = Activation of Y [2]

Activation of X [2]

See sample answer.

(ii) On the pro forma provided (answer number 12 (b)) complete the circuit enabling double acting cylinder **Y** to instroke after a delay in time following the instroke of cylinder **X**.

**Ans** = Activation of Y [2]

Flow regulator [1]

Reservoir [1]

See sample answer.

(c) (i) The two identical double acting cylinders produce a combined force during the outstroke of 706.5N. Calculate the piston diameter if the air pressure is supplied at 0.5N/mm<sup>2</sup>. Assume  $\pi=3.14$ .

$$F = P \times A$$

$$706.5/2 = 353.25$$

$$353.25/0.5 = 706.5 \quad [2]$$

$$706.5/3.14 = 225 \quad [1]$$

$$225 = 15 \times 15 \text{ radius} = 15 \text{ and dia} = 30\text{mm} \quad [1]$$

- (ii) Describe what causes the differences in forces produced by a double acting cylinder during the outstroke and instroke. Discuss how this differs with the forces produced with a single acting cylinder.

**Ans** = Cylinder area differences.

Piston rod

Area reduced for air to work on.

Single acting cylinder during the instroke relies on the force exerted from the spring.

[3]

QWC [1]

Mark for clear and coherent explanation using good English grammar.